CMM/CBM Technologies and Activities in Russia

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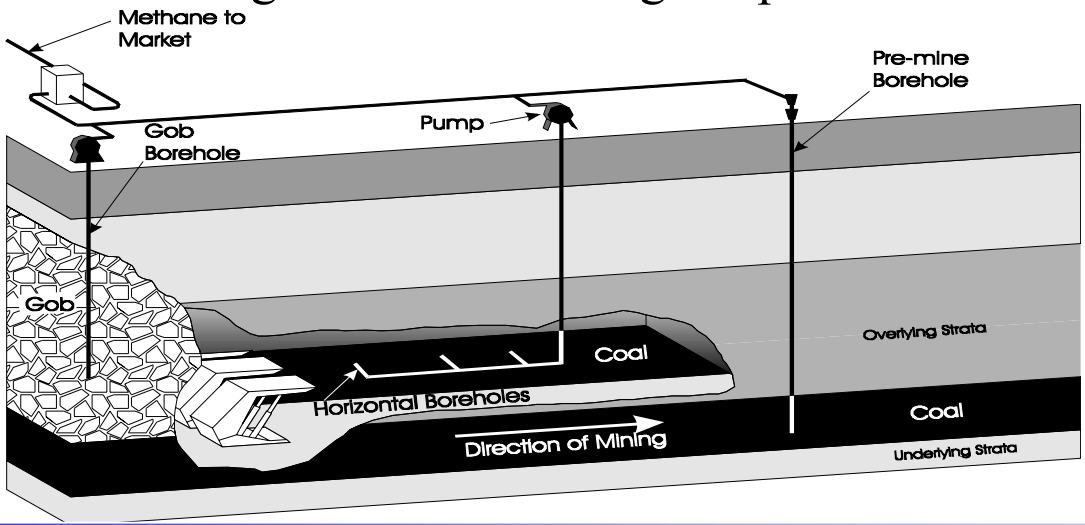
Outline

- What is Coalbed Methane/ Coal Mine Methane?
- CMM as a Greenhouse Gas
- Technical Options and Markets for CMM/CBM in Russia
- Current and Prospective CMM/CBM Activities

What is Coalbed Methane (CBM)?
What is Coal Mine Methane (CMM)?

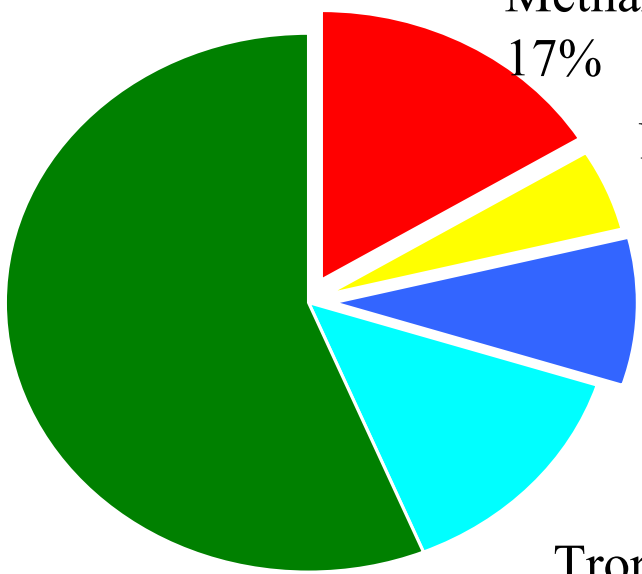
- Coalbed Methane (CBM):
  - Natural gas from coal seams.
- Coal Mine Methane (CMM):
  - A subset of CBM; methane gas released from coal or surrounding rock strata during the process of coal mining.



Methane is a Potent Greenhouse Gas

- 21 Times More Potent Than Carbon Dioxide
- 2nd Only to Carbon Dioxide as a Contributor to Global Warming

Contribution of Anthropogenic Gases to Enhanced Greenhouse Effect



Total = 2.85 Watts/m²

Source: IPCC, 1996.

Tremendous Potential for CMM Emission Reduction

- One CMM Project At One Mine May:
  - Reduce emissions by 100,000 - 1,000,000+ tons/year CO_2 equivalent
- Significant Global Potential:
  - Total global emissions: 475 - 750 million tons CO_2 Equivalent/Year
  - Short-term reductions: 85 - 150 million tons/year
  - Longer-term reductions: 150 - 300 million tons/year

Global CBM Resource Base

(various sources)

Country	Estimated CBM Resource Base (Trillion cubic meters)
Canada	17-92
Russia	17-80
China	30-35
Australia	8-14
US	4-11
Ukraine	2.0-12
India	0.85-4.0
Germany	3.0
Poland	3 .0
United Kingdom	2.45
Kazakhstan	1.1-1.7
South Africa	1 .0
Czech Republic	0.38
Turkey	0.10

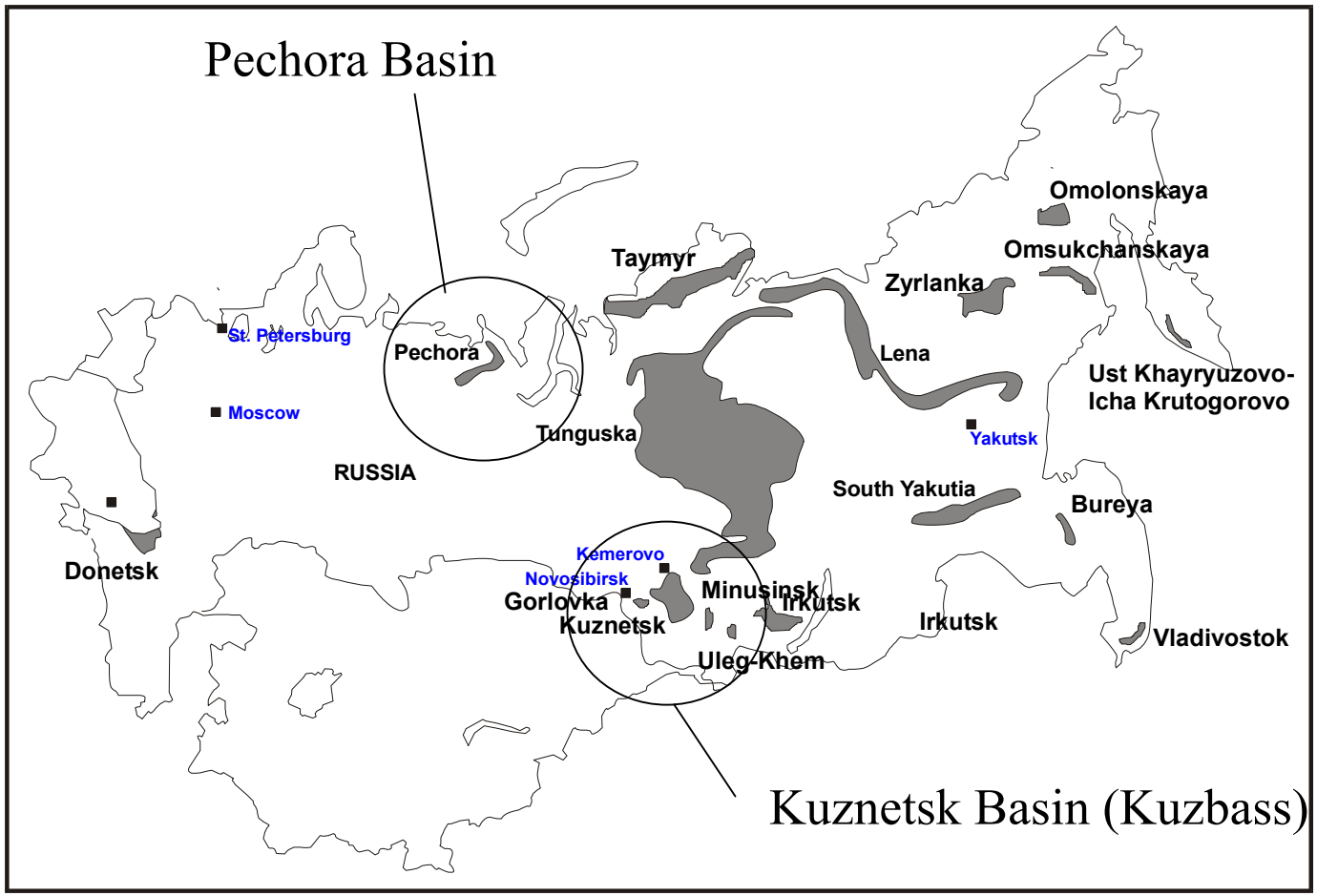
Global CMM Emissions

*Does Not Include Abandoned Mine Emissions

Country	2000 CH4 Liberated (Mln m^3)	2000 CO2 Equivalent (MMT)	2010 CH4 Liberated (Mln m^3)	2010 CO2 Equivalent (MMT)
China	10,000	142.7	15,753	224.7
US	5,461	77.9	5,748	82.0
Russia	2,236	31.9	2,138	30.5
Australia	1,381	19.7	2,004	28.6
Ukraine	1,970	28.1	1,689	24.1
India	683	9.7	1,319	18.8
Poland	1,037	14.8	939	13.4
Germany	1,030	14.7	764	10.9
South Africa	496	7.1	506	7.2
Kazakhstan	488	7.0	447	6.4
United Kingdom	365	5.2	343	4.9
Czech Republic	351	5.0	266	3.8
Turkey	123	1.8	184	2.6
Japan	133	1.9	147	2.1
Canada	98	1.4	91	1.3

U.S. EPA. *Non-CO2 Greenhouse Gas Emissions from Developed Countries:1990-2010*. 2001 and developing country reports

Gassy Coal Basins of Russia



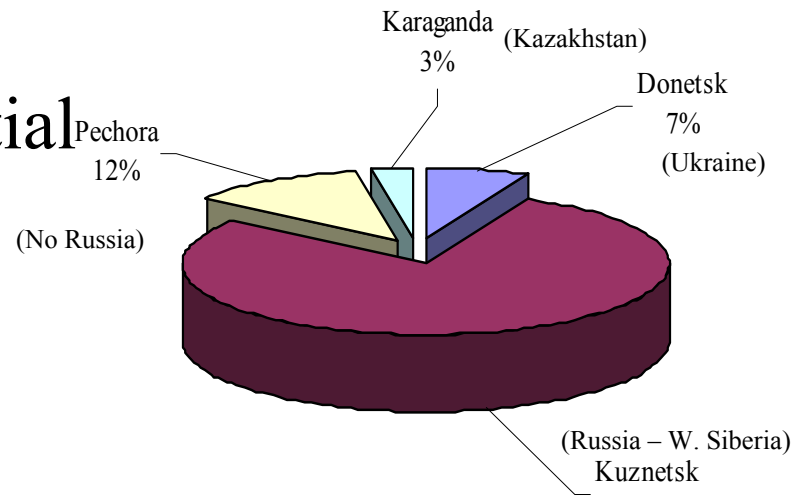
Source: Uglemetan 2002

Current Status of Russian CBM/CMM Industry

- Gas drainage at mines in Kuzbass & Pechora Basins
- Limited CMM utilization
- CBM production is in early, experimental stages (with GazProm)
- National and oblast (regional) governments are encouraging development of CMM/CBM

Most CMM/CBM Efforts Focused in Kuzbass Basin

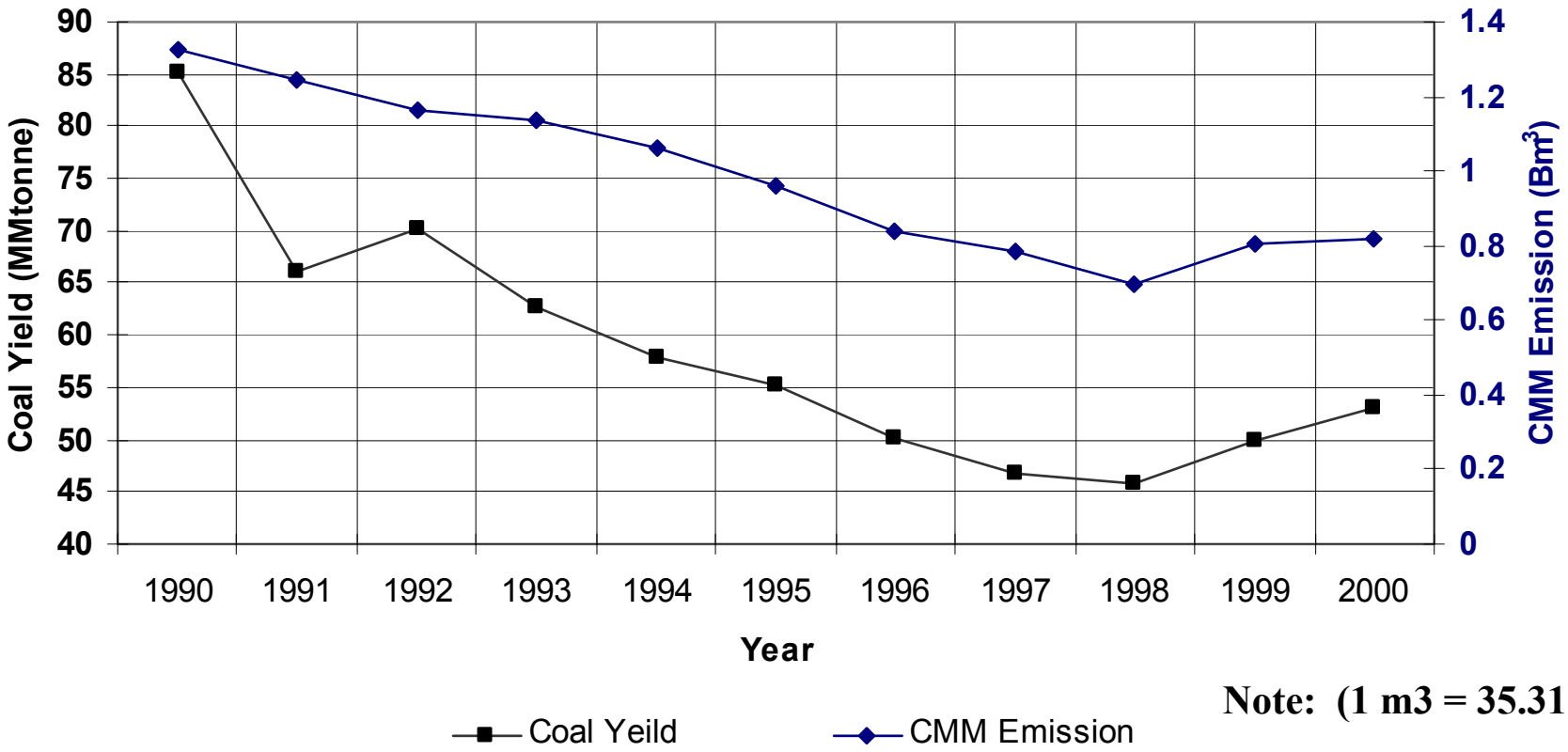
- 78% of CIS CBM resources
- Domestic/export market potential for gas
- CMM GEF project located in Kemerovo
- International Commercial Interest (seeking license)
- Russian CBM Centre, now "Uglemetan," active in promoting Kuzbass CBM/CMM



Source: Uglemetan 2002

Coalbed Methane Resources Distribution Among Coal Areas of CIS

Underground CMM Emission and Coal Output in Kuzbass



Note: (1 m3 = 35.31 cf)

Source: Uglemetan, 2002

Prime Markets for Drained Gas in Russia

- Pipeline Injection
- District or Local Heating
- Boiler Fuel
- Power Generation
- Manufacturing

Coalbed Methane Outreach Program

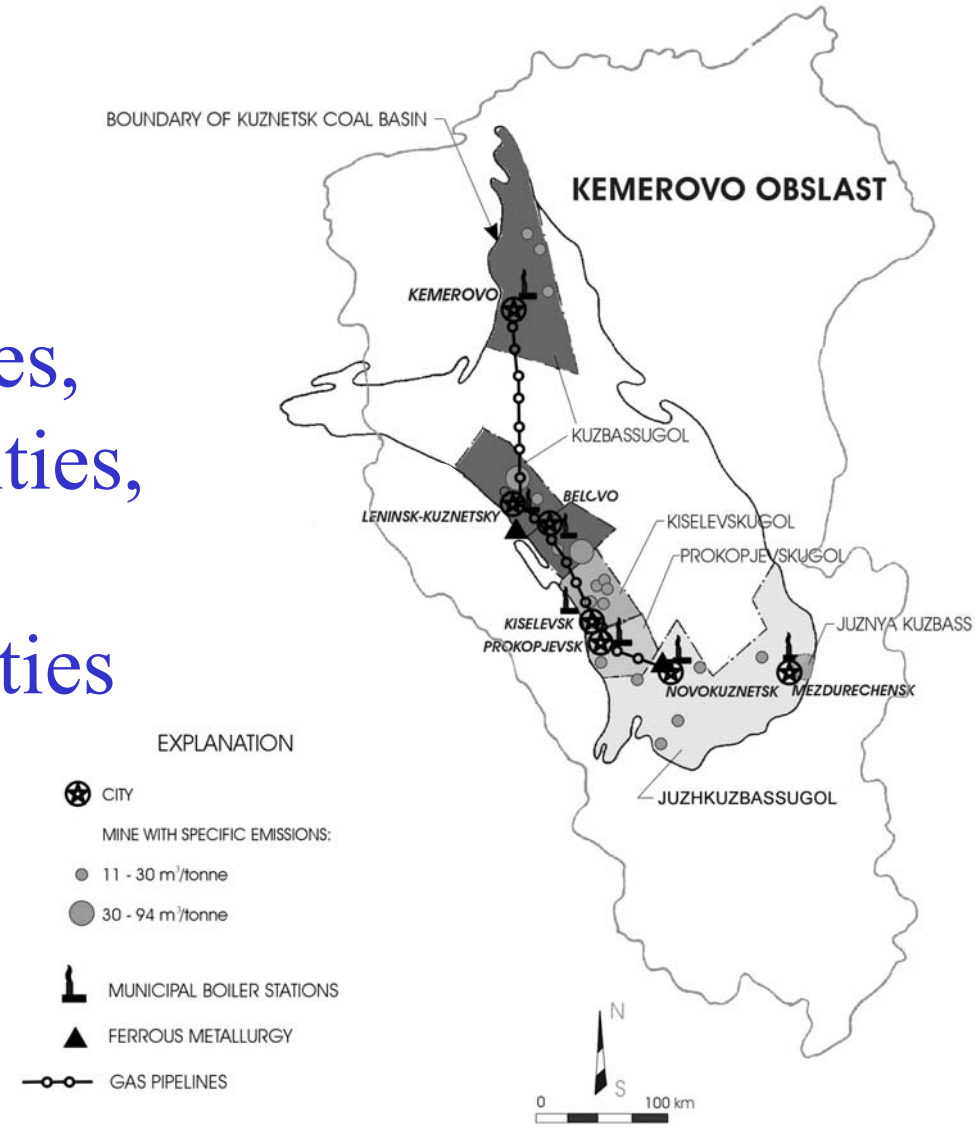
Kuzbass Mines – Potential Projects

Mine	Company	Methane Drained (mil m3)	Methane Drained (MMcf)	Vent Emissions (mil m3)	Vent Emissions (MMcf)	Total (mil m3)	Total (MMcf)
Komsomolets	Kuzbassugol	24.7	872	20.4	720	45.1	1,593
Oktyabrskaya	Kuzbassugol	21.0	742	15.1	533	36.1	1,275
Jubilineynaya	Juzhkuzbassugol	10.4	367	22.1	780	32.5	1,148
Kirova	Kuzbassugol	10.0	353	21.7	766	31.7	1,119
Polysaevskaya	Kuzbassugol	10.0	353	15.5	547	25.5	900
Chertinskaya	Kuzbassugol	9.3	328	7.6	268	16.9	597
Zyrianovskaya	Juzhkuzbassugol	8.7	307	17.2	607	25.9	915
Lenina	Juznya Kuzbass	7.9	279	21.6	763	29.5	1042
Krasnogorskaya	Prokopievskugol	2.7	95	13.4	473	16.1	568
Novaya	Kuzbassugol	2.5	88	9.1	321	11.6	406
Baidaevskaya	Juzhkuzbassugol	2.4	85	4.2	148	6.6	233
Kapital'naya	Juzhkuzbassugol	2.0	71	47.1	1,663	49.1	1,734
Jaroslavskogo	Kuzbassugol	1.6	56	7.4	261	9.0	318
Zarechnaya	Kuzbassugol	1.6	56	3.5	124	5.1	180
Kol'chguinskoe	Kuzbassugol	1.6	56	1.8	64	3.4	120
Totals		**116.4**	**4,110**	**227.7**	**8,040**	**344.1**	**12,150**

Source: *The Kuzbass of Russia: Opportunities for Foreign Investment in Coal Mine Methane Projects* Uglemetan, 2002

Coalbed Methane Outreach Program

Map of Kemerovo Oblast showing the location of Coal Mines, Pipelines, Municipalities, Power Stations, & Manufacturing Facilities



Global Environment Facility

UNDP GEF PROJECT

Removing Barriers to Coal Mine Methane Recovery and Utilization in the Russian Federation

Dates: March 2003 - March 2007

Total Project Costs: US$8.4 million

Estimated GEF financing: US$3.1 million

Status: Approved by GEF Secretariat in October 2002; seeking co-investors

Docs: http://www.gefonline.org/projectDetails.cfm?projID=1162

Mine Ventilation Air a Potential Future Use Option

Photos courtesy of BHP Billiton, MEGTEC, & Environmental C&C, Capstone Microturbines

Ventilation Air Methane (VAM)

- Largest source of coal mine methane in Russia and globally
- Low concentrations makes use challenging
- Technologies now available to use this methane
- Interest growing as mine operators, energy developers, and policy managers grasp energy production and GHG reduction potential

Options for VAM Use

- Supplemental Fuel
  - VAM Used as Feed Air in IC engines at Appin/Tower Collieries in Australia
  - Boilers (e.g. Powerex Australia)
- Oxidation
  - MEGTEC Vocsidizer Flow Reversal Reactor (FRR)
  - CANMET CH4min Catalytic FRR
- Lean Fuel/Catalytic Turbines
- Concentrators

BHP Billiton Appin Colliery

Megtec Thermal FRR

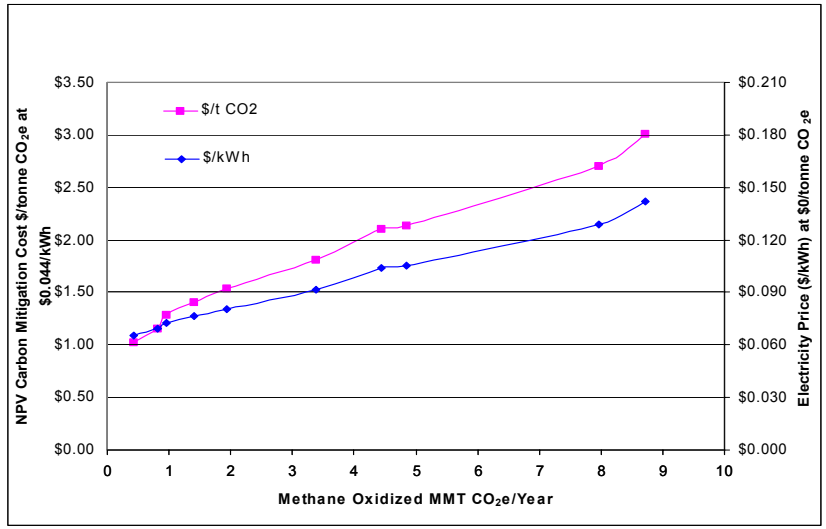
CANMET Catalytic FRR

Capstone Microturbine

Environmental C&C Concentrator

Russia VAM Market Assessment

- Annual Emission Reductions at $3.00/tonne CO2e or $0.14/kWh:
  - 8.5 Million Tonnes CO2e
  - 21 Billion cubic feet
  - 595 Million cubic meters
- Market Potential
  - Generation capacity - 141 MW electricity
  - Revenues from generation - $56 million
  - $498 million equipment market



MAC Analysis Results for Russia

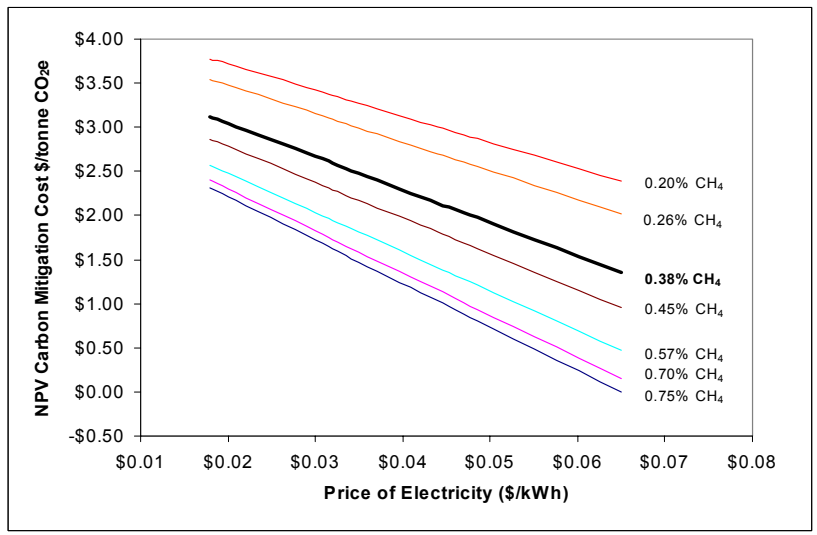


Figure A-10. Opportunity Costs for Russia

Source: *Assessment of the Worldwide Market Potential for Oxidizing Coal Mine Ventilation Air Methane, US EPA 2003*

Issues Related to Future Development of Russian CMM/CBM Industry

- Licensing Regime:
  - Clarity important;
  - Integrated approval for "Exploration" and "Production" desirable in order to encourage risk-taking
- Revenue Streams:
  - Energy prices low;
  - Potential for emission reductions to have value important for CMM projects

Coalbed Methane Outreach Program

UgleMetan

- Uglemetan was established in 2002 as the successor to the Russian Coalbed Methane Centre created under the Russian Academy of Sciences, working now with EPA and Pacific Northwest National Laboratory and several other partners
- Goal - to promote the development of CBM recovery in Russia by providing information and assistance to interested companies and government agencies
- Located within the Kuzbass, in the city of Kemerovo

What Specific Services Does the Uglemetan Provide?

- Disseminating information on development and use of coal mine methane
- Creating domestic industry networks within Russia for information exchange
- Providing information to foreign companies exploring project opportunities in Russia

Summary

- Emissions of CMM, CMB Resource in Russia significant
- Good potential for growth in Russia for CBM/CMM
- Russia still offers challenges to investors but current activities are resulting in development of a Russia CBM/CMM industry

Resources

UgleMetan

- http://www.uglemetan.ru
- mail@uglemetan.ru

- US EPA Coalbed Methane Program
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